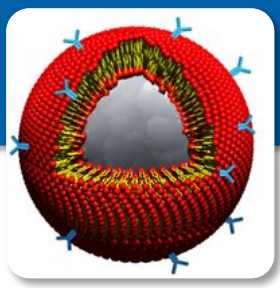
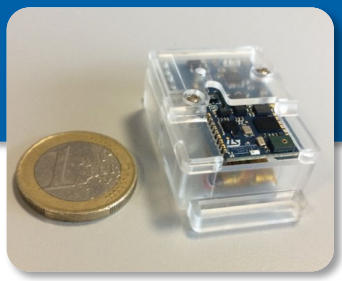
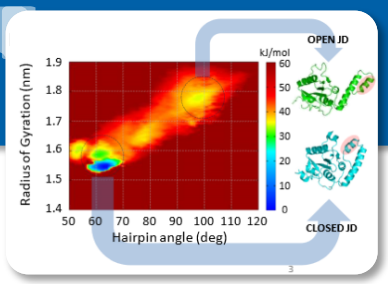
Nanomedicine & Engineering

The shared future view of

Houston Methodist Research Institute and Politecnico di Torino

Politecnico di Torino, December 6, 2019

Auditorium Energy Center, Via Borsellino 38/16, Torino

14:30 – 14:40 Welcome of Director of PhD school of Politecnico and Workshop Introduction

Prof. Eugenio Brusa, Direttore PhD school of Politecnico di Torino
Prof. Danilo Demarchi, Politecnico di Torino, Italy
Prof. Alessandro Grattoni, Houston Methodist Hospital Research Insitute
Introduction to the joint PhD program between Politecnico di Torino and Houston Methodist Research Institute

14:40 – 15:00 Biomedical Micro-Nanofluidics on-Earth and in Space

Prof. Alessandro Grattoni, Houston Methodist Hospital Research Institute

15:00 – 15:20 Recent advancement in nanoparticles development as smart Trojan horses against cancer in nanomedicine

Prof. Valentina Cauda, Department of Applied Science and Technology (DISAT), Politecnico di Torino

15:20 – 15:40 Monitoring of Parkinson's disease motor symptoms using smartphones

Prof. Gabriella Olmo, Department of Control and Computer Engineering (DAUIN), Politecnico di Torino

15:40 – 16:00 Molecular Modelling to Investigate Protein Folding Dynamics and Kinetics in Neurodegenerative Diseases

Prof. Marco Agostino Deriu, Department of Mechanical and Aerospace Engineering (DIMEAS), Politecnico di Torino

16:00 – 16:20 Bio-Inspired Micro&Nano Electronic Systems for Robotics and Biomedical Applications

Prof. Danilo Demarchi, Department of Electronics and Telecommunications (DET), Politecnico di Torino

16:20 – 17:00 Round Table, open discussion with the public and testimonials of former students

17:10 – 17:30 Greetings from Danilo Demarchi and Alessandro Grattoni

Alessandro Grattoni

Chair Department of Nanomedicine, Houston Methodist Research Institute (Tx, USA)

Biomedical Micro-Nanofluidics on-Earth and in Space

This talk will provide an overview of the novel nanofluidic nanotechnologies under development and translation in our laboratory for the controlled delivery of therapeutics and for the transplantation of endocrine cell for the treatment of chronic pathologies. Emphasis will be given to technologies developed for HIV Pre-exposure Prophylaxis, obesity and metabolic syndrome, intratumoral cancer immunotherapy as well as diabetes. Additionally, the work developed in the HMRI's Center for Space Nanomedicine will be presented specifically for what pertains the development and testing of nanotechnologies and rodent studies on board of the International Space Station (ISS).

Valentina Cauda

Department of Applied Science and Technology (DISAT), Politecnico di Torino

Recent advancement in nanoparticles development as smart Trojan horses against cancer in nanomedicine

The use of nanoparticles to fight cancer cells possesses many advantages, like therapeutic efficacy and specificity, enabling the addition of other functions, i.e. targeting selectivity and bioimaging capabilities. However, their potential immunogenicity, aggregation, poor colloidal stability in biological media, rapid degradation and clearance can impair their efficacy. It is therefore of fundamental importance to design biomimetic nanoconstructs with enhanced colloidal stability in human fluids, avoiding immune response.

Zinc oxide (ZnO) nanomaterials are emerging as smart, cutting-edge nanotools showing selective toxicities against cancer cells. Here, the work on zinc oxide nanocrystals of the group of Prof. Cauda is reviewed, showing their efficacy as nano-drugs against in-vitro cancer cells. It is in particular reported on the colloidal stabilization of such nanocrystals into non-immunogenic and naturally stable vesicles, obtaining a final nanoconstructs called Trojan Nano-horse (TNH). The TNH as a whole shows high level of biomimetism and biostability in biological media, high internalization levels into cancer cells, even at low concentrations, and effective cytotoxic activity. Therefore, the proposed TNHs could represent an efficient biomimetic platform for future nano-theranostic applications, facilitating cancer cell death and potential targeting.

Gabriella Olmo

Department of Control and Computer Engineering (DAUIN), Politecnico di Torino

Monitoring of Parkinson's disease motor symptoms using smartphones

Parkinson's disease (PD) is a common neurodegenerative disorder, which leads to disabling motor symptoms. At present, the assessment of PD motor disability is based on pre-scheduled, short duration neurological examination during patient's visits to the clinic, and on diaries self-managed by the patients themselves. Our work aim to provide the clinicians with a sort of "electronic diary" of each patient. This can provide an objective and reliable tool to quantify the disease severity and to monitor both motor symptoms progression and their circadian fluctuations. We employ inertial sensors embedded in commercial smartphones to collect inertial data of patients while performing simple experimental protocols, including different activities of daily living (e.g. walking, turning, standing, postural transitions). Artificial Intelligence techniques are addressed to automatically mimic some tasks of the usual clinical evaluation (i.e., the several UPDRS-part III items). Gait features are extracted, related to disease progression and motor condition of the patient; detection algorithms are designed, capable to catch episodic phenomena (i.e. freezing of gait) typical of advanced stages of the disease; postural stability is evaluated in semi-supervised conditions. Preliminary results have proven that this approach can overcome the well-known problem of inter- and intra-rater variability and makes possible a constant and long-term monitoring of patients, carried in unsupervised environment. This provides clinicians with useful information on the overall patient status, allowing them to the adjust the medication posology and to personalize the overall treatment.

Marco A. Deriu[1] & Gianvito Grasso[2]

[1]Department of Mechanical and Aerospace Engineering (DIMEAS), Politecnico di Torino

[2]Istituto Dalle Molle di studi sull'Intelligenza Artificiale (IDSIA), Scuola universitaria professionale della Svizzera italiana (SUPSI)

Molecular Modelling to Investigate Protein Folding Dynamics and Kinetics in Neurodegenerative Diseases

Proteins are fascinating molecular machines capable of organizing themselves into well-defined hierarchical structures through a huge number of conformational changes to accomplish a wide range of cellular functions. Moreover, alternative protein conformations may enable the exposition of hydrophobic protein domains, increasing aberrant aggregation risk. This is the case of amyloidogenic proteins, where a direct correlation between thermodynamic stability and the propensity for amyloid fibril formation is widely demonstrated. As a consequence, determining protein dynamics, folding kinetics and thermodynamics represents a significant scientific challenge for both experimental and computational approaches to date. Molecular modeling may play a key role in describing protein tendencies towards specific conformational rearrangements and protein-protein organization. Approaching this problem from an energetic point of view is of great importance especially in case of amyloidogenic proteins, given the intimate interconnection between the functional energy landscape and aggregation risk. In this connection, insight can be obtained on protein conformational dynamics and kinetics by structural molecular modelling. This work focus on classical and enhanced sampling molecular dynamics techniques applied to investigate amyloid proteins conformational behavior and their interaction with membranes.

Danilo Demarchi

Department of Electronics and Telecommunications (DET), Politecnico di Torino

Bio-Inspired Micro&Nano Electronic Systems for Robotics and Biomedical Applications

Applications are demanding new approaches to electronic systems. The concept of running for obtaining the best performances in terms of speed and dimensions, that drove the electronic design in the last decades, is no more valid. The electronic systems are nowadays applied in very much different scenarios where sometimes it is not at all important the speed, but power consumption and reliability are the keys. It is strategic to find new approaches that must have an impact at system level. For optimising the afore mentioned aspects, it is strategic the choice of the system level paradigm that will drive all the design choices. For these reasons, it is strategic to take inspiration from the biological systems, applying a merge of the techniques born in recent years and exploiting them for reaching the best *trade off* between quality, and so performances, and power consumption. In the talk will be analysed solutions related to what is named Bio-Inspired Electronics, for applying biological paradigms in system optimisation. As first consequence, it will be presented how it is possible to implement systems that work with digital signals, bringing an analog information, no more based on amplitude or bits, but on a time-based approach.

Celeste Marcato[1] & Marco Farina[2]

[1]Vivisol srl

[2]Omnidermal Biomedics srl

They will be sharing their experience as former Master student (Celeste) and PhD student (Marco) of the joint program between Houston Methodist Research Institute and Politecnico di Torino and how important it has been in order to successfully become Manager of a Leading Healthcare company (Celeste) and co-founder of a young Start-up (Marco).